

1 NuBE R&D

Neutrino Burst Array

2 Model Calculations

need programs to calculate expected signals from all sources

3 Design

We assume that the strawman design is NuBE (4 strings (8 nodes, 16 clusters), buoy for acoustic and satellite comm)

We derive the requirements for this R&D from that design.

We believe we need to measure optical absorption from 300nm to 600nm at the St. Croix site. We need to map wavelength dependence based on the absorption curve of pure water, which has significant structure in this region, varying from <1m to >200m.

4 simulations

optimize design of array

5 Site-Measurement-String design

include current measurement, acoustic communications, 2 Site-Optical-Modules, mechanical, releases, anchors and fixtures

Should we also include the commercial unit from WetLab (\$10k incl. DAQ and power) for point at 670nm?

One string or 2? ie, one string with source - detector distance = 20m and one string with 100m distance? or a single string with detectors at 20 and at 100 m from source?

6 Operations plan

include site measurement string, with backup, and data analysis

Lets do this cost estimate for 2 strings, that way we can deploy them both or deploy in sequence, and we have a spare if we lose one.

Operations include deployment, data collection, monitoring, and analysis.

7 Project Management

include travel and planning meetings. RW,JE,LG,EJ,AT to BNL, or CF, CW, RB, RW to LBL.

8 PDR

Need to review long term goals and make sure the immediate R&D is sufficient.

9 Site-Measurements

Include site-measurement-string (SMS), deployment, analysis.

Need to monitor currrent and optical properties. Also want to test acoustic properties of site on this first drop.

CF has an optical transmissometer that we can get at LBL and see whether it will do the job. Perhaps swap out the light source for a blue LED or put in a bandpass filter etc. May need to modify for 4km depth.

10 SMS Detail Design

We assume that a good overall design is done prior to the PDR, but that schematic level designs are done in this phase.

11 Optical Measurements

We need to measure the absorption length using a commercial unit at 670nm fixed wavelength, and our home-made units at 350 - 450 nm.

12 PMT control

This is the CW base.

13 Light sources

We need a good broadband source from 300 - 600 nm. Prefer pulsable with risetime < 5ns and width <10ns. at rates < 1kHz.

We may be able to purchase the unit but will probably have to make a housing for 4km depth. Can we use Benthos Spheres? Standard battery pack?

14 TRIG and DAQ

This includes all trigger circuitry and data acquisition including data storage and any coupling to acoustic system. This also has to control the light source pulses.

15 Power

We can purchase a battery pack rated for 25kWh and 4km operation.

16 Current Monitors

These come with their own power and DAQ.

17 Sedimentation Monitors

Probably a way to measure deposits on spheres.

18 Acoustic Communication

This should be consultation with company.

19 Mechanical

Basic string with anchor, release, floatation and mechanical mounts for current meters and optical monitors.

Include design of optical module housings and mounts.

20 SMS fab

 $single\ string\ having\ 2\ Site-Optical-Modules\ including\ PMTs, LEDs, DAQ, Storage,\ fiber\ comm.,\ acoustic\ comm.$

21 Optical Modules

We can use existing transmissivity monitors modified to have blue LEDs for this. Actually, there is a much better unit now available, costing \$10k with its own DAQ, from SeaBird Inc.

It is best if we include our own system here as well for a first test of concepts. This will be 2 Site-Optical-Modules having PMT, LED, DAQ, and batteries for each. Is it better to deploy one at a time, one with 20m spacing and one with 100m spacing? or should they be deployed on the same string at different distances?

22 PMTs (4)

Assume we will make three OMs to cover three wavelengths. Plus 1 spare, or 4 total. We may decide to use 2" PMTs with filters on their faces so we already have the tubes, just need bases.

23 Light sources (2)

Assume we will purchase the source, but will have to house and power it for use at 4km depth. Plus one spare for two total.

Lots of uncertainty in estimate.

Allow 30 days for order.

24 Trigger and DAQ (2)

Assume we will have one unit servicing all three PMTs, with 1 spare for 2 total. Requires board fab and home-load.

Assume we will purchase from Benthos, with appropriate connectors. Order is expected to take 30 days. We could use one for DAQ as well, or design and build a steel one for TRIG/DAQ. Design done above could be built in 30d.

26 Power

Direct purchase.

27 Current Monitors

Purchase with expertise. Assume 30 order.

28 Sedimentation Monitors

Not sure what this is.

29 Acoustic Modules

include acoustic communication with string for backup. Since this is our first acoustic task we should include the control unit for the ship end of the system here. This is really just to test the acoustic properties of the site to test 4km 15-20 kHz band communication.

We allow 40 days to process order, since we just purchase this system. We may be able to rent the system and expertise.

30 Mechanical (2 strings)

include string, anchor, float, and releases.

We can re-use two releases that BNL already owns.

31 SMS test

test communication with string both optical and acoustic, and test light signals between optical modules, with TDCs and DAQ and storage.

All modules must be cold tested at 4C for at least 48 hours.

32 Site logistics

need to set up working area at StC

33 SMS deployment

assume this will be done with a local vessel, just throw the string over after using GPS to get to the "site". We won't mark the site more formally unil we analyse the data from this test. Suggest we leave this for 1 month to get tidal information and changes in ioptical properties.

34 Wharfage

For this string we don't really need any fancy shore space since we can test prior to shipment and then again on the ship. We will need to have a long term storage facility (2 mo?), approx. 200 square feet, no air conditioning or anything else.

Do we need any contact with St. Croix if we load the instruments at Harbor Bay in Fla?

35 Ship time

assume this will be a 1 day trip with a local ship. It will take 2 days to load the boat and 1 day to unload it. Thus 3.5 days cost.

For the retireval, this will be a 1 day trip, and we will just take off the boat and put in long term local storage.

36 Logistics

This is our people at St.Croix or Fla. Either place it takes this time to unpack, test, and load on board.

37 SMS Retrieval

We assume we will retrieve the striung after ~30 days at depth.

38 Wharfage

Assuming the 40 days is sufficient this is for clean-up and shipment.

39 Ship Time

The recovery is expected to be a few hours at the site.

40 Logistics

This either St. Croix or Fla, depending on voyage logistics. The task is to pack and ship to Berkeley.

41 SMS analysis

data will be retrieved and analysed at Berkeley

42 SMS project management

include travel and shipping here.

Shipping is 1 container from NY - Fla and return, plus misc from LBL to BNL for a total of \$5k.

Expect to include a pre-deployment site visit here for 4 people at \$6k.

We have 6 - 5 day trips and 4 - 10 day trips for deployment and retrieval. Assuming \$1k RT, \$100 per diem (incl housing), 6 car-weeks at \$200 per week this is \$19k.